

Overview



Making a fiberglass surfboard

This unit reinforces and expands on what students may already know about resources (energy and materials) that originate in natural systems. Through an exploration of the manufacturing process of popular products, students come to understand the crucial role of **natural resources** and energy in creating goods.

The lessons in this unit focus on three phases of manufacturing: the design process during which people make choices about the products and their sources; the **harvesting** and **extraction** of raw goods and materials from natural systems; and the transportation of these **raw materials** from their sources to processing and manufacturing locations, and the

associated energy and resource costs. Students come to understand that multiple inputs and outputs are part of processing and manufacturing the everyday objects and products we consume.

The unit begins with a story about the manufacturing of a California icon—the surfboard. Students read about the origin of materials for a

At a Glance



1

What a Resource!

Explore surfboard manufacturing as an example of natural resources people use.



2

From Natural Resource to Store Shelf

Examine the design process and selecting materials for manufacturing.



3

World Travelers

Identify the sources of natural resources and methods of transporting raw materials.



California Content Standard

6.6. Sources of energy and materials differ in amounts, distribution, usefulness, and the time required for their formation.

6.6.c. Students know the natural origin of the materials used to make common objects.

particular surfboard and about the manufacture of the surfboard. Next they take on the role of owners of a new toy company and begin the process of designing the first toy their company will make.

During subsequent lessons, students refer to the surfboard example to help organize their understanding of the three phases of the resource use cycle in relation to the manufacturing of other products and their toy. As the lessons develop, students learn about the geographic origins of particular resources and raw materials, methods of resource and material extraction and harvesting, and popular means of global transportation of materials for both manufacturing and consumption. Students examine both inputs (natural resources and energy consumed) and outputs (effects of the

California Environmental Principle II

The long-term functioning and health of terrestrial, freshwater, coastal and marine ecosystems are influenced by their relationships with human societies.

Concept A: Students need to know that direct and indirect changes to natural systems due to the growth of human populations and their consumption rates influence the geographic extent, composition, biological diversity, and viability of natural systems.

Concept B: Students need to know that methods used to extract, harvest, transport and consume natural resources influence the geographic extent, composition, biological diversity, and viability of natural systems.

extraction and harvesting methods, emissions, etc.) associated with the acquisition of raw materials and the manufacturing of common products, as well as their influence on Earth's ecosystems. The unit concludes with students applying what they have learned by documenting the inputs and outputs related to the production of a surfboard and their imagined toy.

This unit provides students with opportunities to learn the importance of natural resources to their personal lives. Moreover, students come to understand that the level of human consumption of resources, both through the products people rely on every day and the processes by which those products become available, influences the future of the natural system that is the source of all of resources—Earth.



4

Meet the Extractors and Harvesters

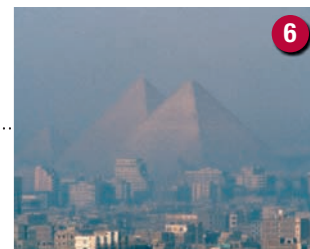
Compare methods used to extract and harvest natural resources in a mock convention.



5

The Effects of Consumption

Assess how human consumption can influence natural systems.



6

What Does It Cost?

Create input-output diagrams for toys they design.

California Connections

A Surfboard Story

The key natural resource in surfboards—oil—formed long ago in ancient oceans, perhaps right here in California. Marine animals that died millions of years ago drifted down to the ocean floor. Heavy layers of sand trapped the dead animals' bodies in airtight pockets. The heavy sand and water pressed down and over long periods created fields of sticky black oil.



Skip forward a few million years. Now in many areas of California, as well as off the coast, people extract this oil with drilling rigs. When workers first install a rig, pressure from the site forces the crude oil to the surface. Over time this pressure decreases. When the pressure drops too low to force the oil upward, workers add a rocking arm and continue to pump the oil from the ground.

The crude oil often contains materials that people cannot use. Workers remove these unwanted materials by putting the oil in settling tanks or separators. Then they ship the oil by pipeline or by truck to a refinery.

Manufacturers purchase some of the oil to make polyurethane, a chemical compound used in foams, elastics, and resins, and the key ingredient in most modern surfboards. The manufacturer usually ships the polyurethane by truck or train to a wholesaler, who unloads it and stores it for later sale.

From the wholesaler, truck drivers take the polyurethane to a surfboard manufacturer. In the surfboard factory, workers heat the polyurethane

in a cement mold for 25 minutes. The heat triggers a chemical reaction and dense, white foam begins to froth. After it cools, builders use this foam to make the core of the surfboard.

The builders slice this white foam core (also called a blank) in two, lengthwise, like deli bread. A 1/8-inch piece of wood acts as the “meat” in this “surfboard sandwich” when builders glue it into place. The builders then clamp the surfboard shut to allow the glue to dry. The stringer prevents the surfboard from breaking in half.

Fiberglass Facts

As the surfboard hardens, you have time to look at the resources used to make the fiberglass. The process of making fiberglass uses three major ingredients: silica sand, limestone, and soda ash.

Like oil, limestone forms from the remains (shells and bones) of ancient sea creatures. Wave action breaks up the shells and bones of marine animals and deposits the pieces on the ocean floor. Over millions of years, layers of shells, sand, and mud harden into limestone. People extract this abundant resource from many different places. Sometimes quarry workers take it from deposits



Surfer paddling

on Earth's surface. In other places, miners extract limestone from underground deposits or caves.

Extracting soda ash is much different from limestone mining. In nature, soda ash is often invisible, since it dissolves in some lakes or accumulates in salt beds. People extract its white powder from these natural sources. However, scientists can also create soda ash in a lab.

The third key material in fiberglass is silica sand, which contains a lot of quartz. Over many years wind and water slowly grind quartz rocks into silica sand. People extract the silica sand from beaches, riverbeds, and lakes.



Oil Rig near the Channel Islands

Mining companies use trucks or trains to ship the three minerals used to make fiberglass to wholesalers. The wholesalers sell the minerals and load them back onto trucks. The truckers deliver the minerals to the fiberglass manufacturer, where workers unload and store the minerals until they are needed.

Creating Glass Threads for Fiberglass

The manufacturer carefully weighs each raw material to get the exact quantities needed to make fiberglass. The workers mix the ingredients together and feed the batch into a furnace. To make glass fibers, the temperature must be very hot—approximately 2,500°F (1,371°C).

When the silica sand melts, it forms liquid glass. The molten glass goes into a machine with hundreds of small holes. The machine draws the glass through the holes, creating thin strands, or threads. These threads go into making many different fiberglass products. Workers load the products onto delivery trucks and ship them to manufacturers such as the surfboard maker.

Meanwhile, Back at the Surfboard Sandwich

Now that the surfboard core and stringer are dry, a saber saw cuts around the drawing of the outline of the surfboard. Then a motorized planer levels out the final shape. (A planer is a machine that evens things out.)

A big sander goes to work next, repeatedly sanding to remove ridges from the surfboard blank. As a last step in shaping, builders mark the position of the surfboard's fin. Many builders add their own special designs, or signatures, to identify their work. Then they blow the finished blank clean with compressed air.

To make the surfboard colorful, builders spray on paint with an airbrush or spray gun. Then they dry the surfboard once more.

The key to making the surfboard last a long time comes in the next stage, called glassing. In glassing, builders layer fiberglass sheets and resin. Resin is a thick fluid produced by plants or, more commonly, manufactured from oil-based chemicals. Resin is strong and keeps the surfboard from chipping or cracking.

After glassing, builders coat the board with one more layer of resin to plug any flaws on the standing surface, called the deck. They flip the board over and position the fin. Next the builders wrap fiberglass tape around the fin and add resin to it. Finally they coat the surfboard's underside and fin with a filler layer of shellac which is made from trees. Later, when the entire surfboard is dry, the builders drill a small hole in the tail for a leg leash.

A final round of sanding removes any excess resin. More dust flies as the compressed air puffs the board clean. The builders add decals and graphics before brushing a final coat of shiny gloss resin over the board in the last 15 minutes before it hardens.

In another 12 hours the surfboard receives its final rubbing, buffing, and polishing. Later, workers stack it with other finished surfboards, where they wait to be loaded onto trucks and delivered to surf shops around California and the country.

Surfboard Shopping

Two weeks later, a surfer walks into a surf shop. She tells the clerk she wants a sturdy surfboard, but one that is easy to carry. Thirty minutes later, she tucks her new surfboard under her arm and walks out of the shop to her buddies. They drive to the beach, unload their gear, and get ready to paddle out past the breakers.

Sitting on the shore with a friend, you look up a little while later to see this surfer carefully stand for the first time on her new surfboard. As she steadies herself, you turn to your friend and smile as you ask, "Hey, dude, do you know how surfboards are made?" When he shrugs, you say, "Well, it all began in an ocean a lot like this one millions of years ago..."

